PARASITISM OF THE AUSTRALIAN PLAGUE LOCUST *CHORTOICETES TERMINIFERA* (WALKER) (ORTHOPTERA: ACRIDIDAE) BY *PRIONYX SAEVUS* (SMITH) (HYMENOPTERA: SPHECIDAE)

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Abstract

The sphecid *Prionyx saevus* (Smith) is recorded parasitising the Australian plague locust, *Chortoicetes terminifera* (Walker), in western New South Wales during an outbreak in 1979. Observations on nesting behaviour are given and evidence is presented of possible migration with host swarms. The inquiline *Protomiltogramma cincta* Townsend is recorded infesting a high proportion of hosts at one *P. saevus* nesting site. Despite the conspicuous activity of *P. saevus* described, it is concluded that *P. saevus* caused an insignificant reduction of host numbers during the outbreak.

Introduction

The observations of the behaviour of *Prionyx saevus* (Smith) reported in this paper were made during the course of routine surveys of activity by the Australian plague locust, *Chortoicetes terminifera* (Walker), during the initial phase of the 1979 plague (Baker 1979). *P. saevus* was observed at fourteen localtions in the Far North West and Lower Darling districts of New South Wales between January–April 1979, and at nine locations in the Central Western Plain during November–December 1979 (Fig. 1). Observations in January 1979 were of concentrated nesting activity by *P. saevus* during a period of active swarm migration by its host *C. terminifera.* This paper reports on two of these populations of *P. saevus:* Weinteriga Tank (142° 51′E, 32° 04′ S) and Boolaboolka Lake (143° 07′ E, 32° 36′ S). Further sightings in March and April 1979 were of less conspicuous activity by individual *P. saevus* associated with low density residual populations which remained in the Far North West following mass emigration on 20th March, 1979 (Baker 1979). Sightings in the Central Western Plain in November–December 1979 were of small concentrations and individuals associated with actively migrating swarms.

P. saevus has not previously been reported as a parasite of *C. terminifera.* The yellow-winged locust, *Gastrimargus musicus* (F.) has been recorded as a host of *P. saevus* in Queensland (Common 1948). A specimen of *P. saevus* in the Australian National Insect Collection is pinned with a female *Zabrala ceripes* Sjöst. (Acrididae) (E. Evans, pers. comm.).

Female sphecids capture prey which they paralyse and bury in a ground nest; an egg is placed on the immobilised prey and after hatching the larva develops as an external parasite, killing its host (Evans 1958). Sphecids have been variously termed predators (Greathead 1963) and parasites (Rees 1973). The latter convention has been adhered to in this paper.

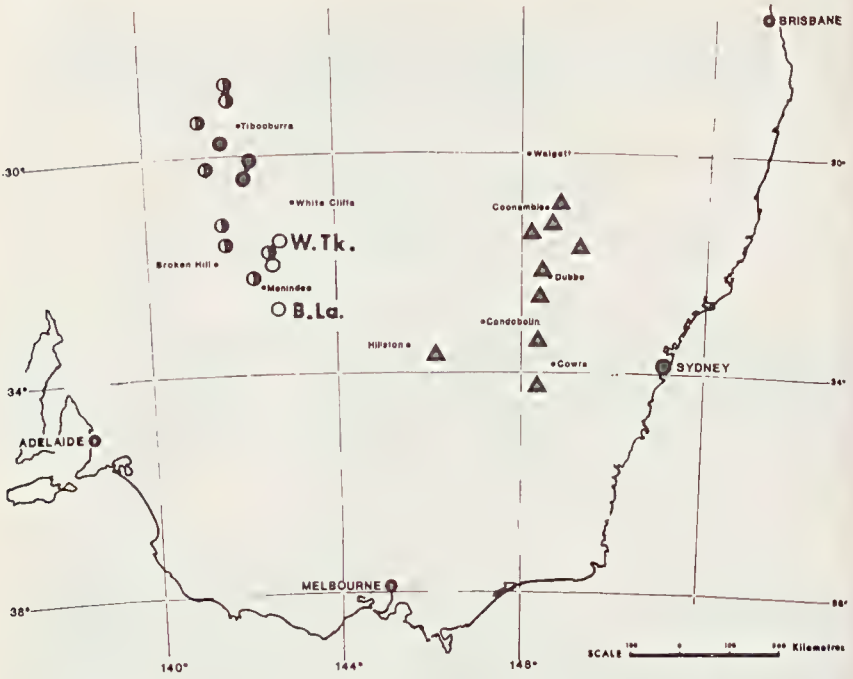


Fig. 1. Records of *Prionyx saevus* associated with *Chortoicetes terminifera* swarms during the 1979 plague: ○, 29-30th January, 1979; ◑, 1-6th March, 1979; ●, 13th April, 1979; ▲, November-December, 1979; W.tk., Weinteriga Tank; B.La, Boolaboolka Lake.

Life history of *P. saevus*

Distribution of nesting sites:

At both the Weinteriga Tank (Fig. 2) and Boolaboolka Lake sites (Fig. 3) nest of *P. saevus* were restricted to the coarse red sand used in the road's construction. Few nests were located on the outside fall of the table-drain and none in undisturbed soil (heavy grey clays) beyond the table-drain (Fig. 4).

Intense nesting activity was confined to an area of approximately 0.6 ha at both sites (40 x 150 m: Weinteriga Tank site; 40 x 120 m: Boolaboolka Lake site). At the Boolaboolka Lake site the length of the roadway over which *P. saevus* was active corresponded to the width of a low density drift of *C. terminifera.* At this site, the concentration of nesting sites appeared to be primarily dictated by the abundance of prey.

Nest density:

Nests within the nesting area at the Weinteriga Tank site were at a radial spacing of approximately 1.5 metres; sufficient to prevent overlapping of chambers. At the Boolaboolka Lake site the maximum nest density was 1: 2.76 m^2 (94 nests in an area of 260 m^2) and the average nest density on

Figs 2-3. *Prionyx saevus* nesting sites: (2) Weinteriga Tank, 29th January, 1979, viewed towards the north-east; (3) Boolaboolka Lake, 30th January, 1979, viewed towards the north-west.

the shoulder of the road (the preferred location) was 1: 4.57 m^2 (225 nests in 1030 m^2) (Fig. 4).

Nest construction:

Nests are of diagonal type according to the classification system of Evans (1958) and multi-chambered. The number of chambers in six nests excavated at the Weinteriga Tank site ranged from 5 to 11 (mean = 7). Chambers were located at depths ranging from 9 to 23 cm with the majority located between 10 and 13 cm (Fig. 5). Soil from the nest was always deposited on the lower slope with chambers radiating out from the entrance below the upper slope (Fig. 2). One instance of small pebbles (10-15 mm) being placed over the entrance was observed. The majority of nests had a conspicuous entrance with no evidence of any attempt at concealment (Fig. 2).

One series of observations made at the Weinteriga Tank site on 29.i.1979 between 1500-1600 hrs typifies the behaviour of a *P. saevus* female: the host was taken prior to chamber construction and concealed in a hide a short distance from the nest. The hide consisted of a large clod of clay located 2.55 m from the nest. During the construction of the chamber five brief visits were made to the hide at intervals ranging from 2-25 minutes. When chamber construction was complete (56 minutes after observations commenced) the host was transferred to a new hide: under a "paddy melon vine" 18 cm from the nest entrance (Fig. 6). The female re-entered the nest five times over a two minute period bringing minimal soil to the surface. This activity may have been to clear the tunnel rather than further expand the chamber. The host was then brought to the nest entrance and placed with its head at the nest entrance. The female then entered the nest and immediately turned and commenced to back into the nest pulling the host in head first (Fig. 7). The female re-emerged after 6.5 minutes and commenced filling by flicking soil roughly into the nest with forelegs. The nest was entered for four brief periods of 5-15 seconds over a two minute period. The female then vacated the area with no attempt having been made to conceal the nest entrance.

In observations on other females the interval between entering nest with host and the commencement of filling occupied one minute 40 seconds and two minutes 10 seconds. Filling consistently occurred over a 2-3 minute period.

Host range and oviposition:

All 77 hosts recovered from chambers were adult female *C. terminifera.* The host is placed in the chamber head-in with a lateral surface uppermost. A single egg is laid on each host. The egg is laid on the upper lateral surface with the anterior end opposed to the membranous area immediately posterior to the epimeron of the metathorax. The remainder of the egg is arched over the hind-femur (Fig. 8). Evans (1958) reports a similar placement of eggs in

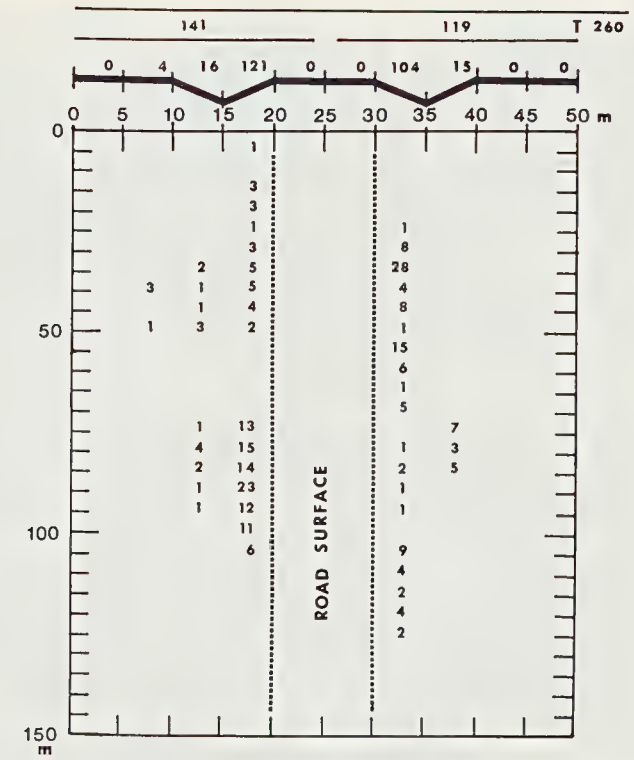


Fig. 4. Distribution of *Prionyx saevus* nests within a plot of 0.75 ha at the Boolaboolka Lake site, 30th January, 1979. Number in sub plots of 25 m^2 indicated.

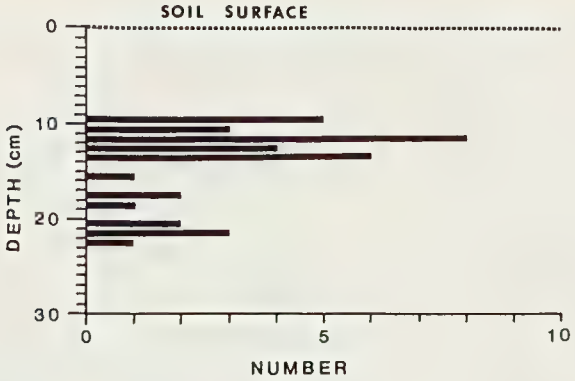
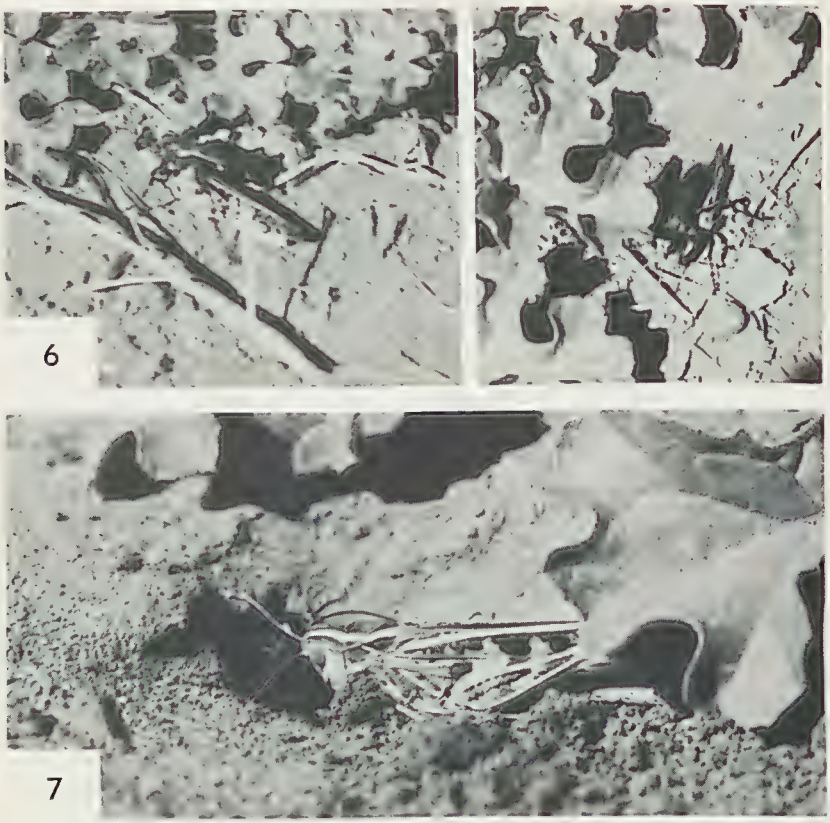


Fig. 5. Frequency distribution histogram of the depth of *Prionyx saevus* chambers in red sand at Weinteriga Tank site.



Figs 6-7. Transport of *Chortoicetes terminifera* by *Prionyx saevus*: (6) two views of female *P. saevus* straddling *C. terminifera* during transport from hide to nest. Note base of antenna grasped in mandibles and fore legs crossed under neck of host; (7) transporting host into nest.

several North American species of *Prionyx*. Frequently the paralysed locust had lost one hind leg (13 out of 42 at the Weinteriga Tank site; 11 of 35 at the Boolaboolka Lake site) and the egg was invariably deposited on that side.

Larval and pupal development:

No eggs had hatched when hosts were examined on 29-30th January, 1979. Hosts bearing eggs were collected at both sites but all eggs failed to hatch due, in part, to infestation by larvae of the inquiline, *Protomiltogramma cincta* Townsend (17 out of 19 hosts from Boolaboolka Lake site infested).

At a subsequent inspection of the nesting sites on 6th March, 1979, 19 empty *P. saevus* pupal cases were recovered from three nests at Weinteriga Tank site and one empty pupal case and one viable pupa were recovered from six *P. saevus* nests at Boolaboolka Lake site: development from egg to adult

Fig. 8. Two views of *Prionyx saevus* egg on lateral surface of pterothorax of *Chortoicetes terminifera.*

having been completed in less than the 35-36 day interval between observations. Soil temperature at a depth of 10 cm during February would approximate the mean monthly temperature of 26.3°C (Menindee; Bureau of Meteorology).

Migration of *P. saevus* with *C. terminifera*

A swarm of *C. terminifera* (> 1000/100 m^2) was reported at the Weinteriga Tank site on the afternoon of 28.i.1979 together with large numbers of *P. saevus* (R. Fitzgerald, pers. comm.). When the site was inspected at 1400 h on 29.i.1979 the *C. terminifera* adults were at a density of only 10/100 m^2 and few *P. saevus* were present; three adults sighted between 1400-1600 h. There was ample evidence of considerable prior activity by *P. saevus* in the area. A light drift of *C. terminifera* (≈ 500/100 m^2) was present at the Boolaboolka Lake site between 1000 and 1200 h on 30.i.1979. *P. saevus* was still active in the area (12 individual *P. saevus* observed in two h period), however, the large number of nests (260 in an area of 0.75 ha) would indicate intense prior activity by *P. saevus.* The apparently rapid decline in the abundance of *P. saevus* at both sites appears to have coincided with a reduction in host density following departure of the swarm from the nesting area, indicating dispersal (or migration with the departing swarm) by *P. saevus* is in response to a decrease in the availability of prey. Migratory behaviour

has been reported for *Sphex aegyptius* Lep. which preys on *Schistocera gregaria* Forskal (Haskell 1955).

Discussion

The influence of parasitism by *P. saevus* on the population dynamics of *C. terminifera* during outbreaks is slight. If the level of activity at the Boolaboolka Lake site is typical, then 2.5 x 10^3 hosts ha^{-1} would be taken from a possible host population of 40 x 10^3 ha^{-1} (in the *P. saevus* nesting area) or 5.2 x 10^6 (in the swarm) (based on typical locust densities reported in Casimir 1976). *P. saevus* was associated with only three of 43 *C. terminifera* swarms observed in the Far North West during late January 1979.

The influence of *P. saevus* on the population dynamics of *C. terminifera* may be of more importance at low host densities. In a study by Clark *et al.* (1969), densities of *C. terminifera* of less than 200 ha^{-1} were recorded in the Channel country of Queensland. At such densities, the activity of a single *P. saevus* female could significantly reduce the reproductive capacity of the population through its selective parasitism of female hosts.

Acknowledgements

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